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Decommissioning Utlility-Scale Solar Facilities

Financial Best Practices for Virginia Localities

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How can Virginia localities hosting utility-scale solar projects minimize their risk of bearing decommissioning obligations without increasing barriers to such projects?

This report seeks to offer a practical inventory of regulatory options which localities can adjust based on a utility-scale solar project's characteristics. The author analyzes decommissioning best practices with respect to context-appropriate site removal and land restoration regulations, legal protections for the locality, financial assurance mechanisms and posting methods, and adjustments to decommissioning security which account for inflation, any administrative factor, and salvage credit. Decommissioning regulations required by state law are distinguished from those which a locality may enforce at its discretion.

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ABBREVIATIONS

AEP: American Electric Power

ApCo: Appalachian Power Company

BLS: Bureau of Labor Statistics

CPCN: Certificate of Public Convenience and Necessity

DEQ: Virginia Department of Environmental Quality

EoL: End-of-Life

EPA: U.S. Environmental Protection Agency

FA: Financial Assurance

kWh: Kilowatt hours

LC: Letter of Credit

MW: Megawatt

NRCS: Natural Resources Conservation Service

NREL: National Renewable Energy Laboratory

NRSRO: Nationally Recognized Statistical Ratings Organization

NYSERDA: New York State Energy Research and Development Authority

PBR: Permit-By-Rule

PJM: PJM Interconnection, LLC; PJM abbreviates Pennsylvania, New Jersey, and Maryland, the initial territories whose utilities joined together into an RTO. PJM now operates in all or parts of Delaware, Ohio, Virginia, Kentucky, North Carolina, West Virginia, Indiana, Michigan, and Illinois.

PPA: Power Purchase Agreement

PPI: Producer Price Index

PV: Photovoltaic

RCRA: Resource Conservation and Recovery Act of 1976

RPS: Renewable Energy Portfolio Standard

RTO: Regional Transmission Organization

SCC: State Corporation Commission

SEC: U.S. Securities and Exchange Commission

SEIA: Solar Energy Industries Association

USDA: United States Department of Agriculture

TCLP: Toxicity Characteristic Leaching Protocol

VCEA: Virginia Clean Economy Act

EXECUTIVE SUMMARY

When any large energy generation facility reaches the end of its project life, it is commonly decommissioned in accordance with local, state, and federal guidelines: The facility owner disposes of site infrastructure and restores the facility's real property to a condition suitable for its subsequent use. As is the case with other energy facilities, localities appropriately request specific decommissioning plans and financial assurance from the owners of utility-scale solar facilities in advance of decommissioning. While the financial assurance amounts appropriate for utility-scale solar projects can be quite large—hundreds of thousands of dollars or more—utility-scale solar decommissioning is relatively less expensive, time-intensive, and environmentally disruptive than is the case for decommissioning end-of-life (EoL) nuclear, coal, natural gas, and oil well facilities.

To date, it can be challenging for Virginia localities to access contextualized guidance for creating decommissioning policies which both minimize the locality's exposure to the risk of bearing decommissioning obligations and avoid imposing excessive or superfluous costs on the developers and owners of utility-scale solar projects.

Because the Code of Virginia establishes a hybrid regulatory structure for solar energy, localities have the authority to regulate the siting and decommissioning processes for solar facilities beyond the requirements of state law and the responsibility to enforce both state and local solar ordinances (Va. Stat. §15.2-2241.2, 2019; Va. Stat. §§15.2-2288.7:2288.8, 2021; Va. Stat. §§15.2-2316.7:2316.9, 2021). While the local regulations governing utility-scale solar sites vary, a locality-approved plan for decommissioning an end-of-life plant and restoring the facility site is often required for construction to begin. By developing and applying comprehensive, context-appropriate strategies for decommissioning end-of-life (EoL) large- and utility-scale solar projects, localities can ensure that land is left in usable condition at the end of a solar facility's useful life.

This analysis evaluates several local policy strategies for managing utility-scale solar decommissioning in the Commonwealth of Virginia:

1) Establishing an effective decommissioning ordinance;
2) Defining a legal framework to enforce decommissioning;
3) Requesting appropriate forms of financial assurance; and
4) Factoring salvage credit, inflation, and administrative costs.

This paper distinguishes among (i) the decommissioning regulations a locality must enforce, as required by state law, (ii) those which the county or city has the authority to enforce at its discretion, and (iii) discretionary regulations which are recommended as best practice for the locality. An overview of the topics and recommendations of this paper is provided below.

DECOMMISSIONING ORDINANCES

A decommissioning ordinance states the minimum decommissioning requirements to be executed by a solar facility's owner at the end of the project's life or upon abandonment, and the appropriate contents for a decommissioning plan that a developer should file with the locality prior to initiating site construction. The requirements of a decommissioning ordinance may be formally incorporated into a locality's existing zoning ordinance, solar ordinance, or other municipal code. If no local law specifies minimum decommissioning requirements, then a locality may instead issue site-specific decommissioning requirements as a component of a conditional use permit, special use permit, siting agreement, or special exception. A locality with laws regulating decommissioning may also create a site-specific decommissioning ordinance with stricter or additional provisions. Virginia localities commonly include decommissioning provisions as a component of their solar ordinance, and these provisions apply to large- and utility-scale solar projects. Localities also have the authority to adopt a decommissioning ordinance independently of adopting a solar ordinance.

A locality's decommissioning ordinance should define key terms, such as decommissioning and abandonment; specify financial assurance requirements, salvage allowances, and the processes for accurately adjusting costs due to annual inflation and changes in secondary markets for solar materials; and state the conditions for sediment and erosion control compliance, post-closure land-use, and land restoration. Localities may also consider suggesting the minimum conditions a facility's owner or affiliate should fulfill if they seek to extend the life of the facility by installing new solar panels, a process known as *repowering*.

LEGAL FRAMEWORK IN CASE OF ABANDONMENT

Localities may protect themselves against bearing decommissioning costs by stating the conditions which affect access to financial assurance. These methods include defining facility non-performance and abandonment, stating the point at which financial assurance instruments are activated, requiring a special permit application in which the decommissioning plan is codified in the locality's zoning ordinance, issuing site approvals or permits with an abandonment and removal clause, and specifying a temporary variance.

FINANCIAL ASSURANCE

Localities may access a menu of financial assurance (FA) options that cover the full cost of decommissioning. Different forms of FA are appropriate in different circumstances. Common FA mechanisms include but are not limited to:

- trust funds,
- cash escrow,
- irrevocable letters of credit,

- surety bonds guaranteeing payment or performance,
- insurance,
- financial tests, and
- guarantees by an investment-grade entity, such as a parent guarantee or promissory letter.

It is in both the locality's and the developer's best interest to minimize the costs associated with posting security. The type of FA a locality should require of a developer and the time or times at which it should be posted are context dependent. The surety amount available to the locality should be periodically adjusted based on a Virginia-licensed engineer's re-evaluation of decommissioning costs. Although the appropriate timeframe for posting decommissioning security may vary by solar project, a locality should in every case require the site owner to post FA until the decommissioning process has been completed.

SALVAGE CREDIT

It is at the locality's discretion whether to allow a salvage credit. While state law does not require the inclusion of a salvage credit against decommissioning costs, it is good practice for a locality to allow a salvage credit for the portion of solar hardware that can be resold for scrap value or reuse at the end of a facility's operating life. A salvage credit need not equal the total estimated salvage value. A locality can protect against fluctuations in salvage value by using a salvage credit calculation which includes a reserve value.

PROBLEM STATEMENT

A utility-scale solar facility, once built, is very likely to remain economically productive for a long period of time. A solar panel can remain in service for 30 years or longer. An owner or operator of a grid-connected solar facility is unlikely to abandon a utility-scale project during its expected lifetime because of the high value of power produced and contractual obligations arising from the project's long-term economic value (North Carolina DEQ, 2022, p. 4). Even as the initially installed panels age, project owners will very often face a strong incentive to install new panels on the existing site, a process known as repowering. But any industrial facility can reach an end to its useful economic life, so it is in the locality's interest to establish clear decommissioning conditions so that (i) should a project owner become financially insolvent, the locality does not incur the responsibility of decommissioning the solar project, and (ii) at the end of a project's life, retired equipment is responsibly managed and the land is appropriately restored, prepared for redevelopment, or equipped for repowering.

Utility-scale solar development will likely continue to increase as the Commonwealth as Virginia is forecast to face higher energy demands over the next decade (PJM, 2022; Shobe, 2021), as Dominion Energy and Appalachian Electric Power continue to comply with the Virginia Clean Economy Act (Duimstra, 2021), and as the costs of solar generation continue to fall (Basore & Feldman, 2022; Davis et al., 2021; McGowan, 2021; U.S. EIA, 2020). Host localities will benefit from timely access to an inventory of guiding practices in anticipation of these facilities' eventual decommissioning.

The practices detailed in this paper seek to help localities protect against the risk of bearing decommissioning costs while simultaneously reducing developers' barriers to installing utility-scale solar projects.

BACKGROUND

WHAT IS A UTILITY-SCALE SOLAR FACILITY?

For the purposes of this report, a *utility-scale solar facility* is any ground-mounted solar photovoltaic (PV) project with the nameplate capacity to generate five or more megawatts (MW) of electricity—as measured in alternating current—then injected to the grid for offsite consumption, in accordance with the threshold set by the National Renewable Energy Laboratory (NREL, 2022). The term *large-scale solar facility* refers to installations with a capacity of at least one MW; utility-scale facilities are by definition large-scale solar plants.[1]

Something less than ten acres of land are required for each MW of solar capacity: One somewhat dated study estimates a capacity-weighted average ranging from 7.3 acres per MW (direct land-use) to 8.9 acres per MW (total land area) (Ong et al., 2013). This land footprint has likely fallen as more efficient solar panels have become available. Solar cell efficiency has increased from 18% in 2015 to over 22% in 2021. The Solar Energy Industries Association currently reports a range of between 5 and 10 acres per MW, depending on specific site characteristics. The total number of solar PV panels installed per acre is site-specific, varying with terrain, hardware characteristics (e.g., tracking versus mounted panels), and setup decisions (e.g., spacing between arrays, angled versus flat configuration). Back-of-the-envelope calculations based on publicly accessible data from the North Carolina DEQ suggest that, depending on solar technology and site conditions, roughly 2,500 to 5,050 solar panels are required to produce one MW of electricity (Scott, 2022).

Utility-scale solar facilities average a project life of thirty years, after which point installed solar PV panels produce electricity at approximately eighty to eighty-five percent of their rated capacity (Curtis, Buchanan, Smith, & Heath, 2021; Atasu, Duran, & Wassenhove, 2021). The increasing efficiency of solar technology (Basore & Feldman, 2022) offers both a lengthened project life in the future (Curtis et al., 2021) and the opportunity to repower existing utility-scale projects with more efficient, higher output panels. (MDOC, 2018, p. 4).

ECONOMIC CONTEXT

Researchers project that over the next two decades, solar energy systems will drive at least fifteen percent of the forecasted 5.9 trillion kWh global increase in new electricity generation from renewable energy sources (Eissa & Tian, 2017). The levelized cost of photovoltaic energy is further predicted to decrease through at least 2030, indicating the potential for lower energy costs and

[1] *Author's Note:* The U.S. Energy Information Administration (EIA, 2019), the Solar Energy Industries Association (SEIA, 2022), and many local ordinances define "utility-scale solar" as PV capacity greater than 1 MW. This paper applies a 5 MW threshold for utility-scale solar and a 1 MW threshold for large-scale solar for internal consistency.

higher investment returns (Creutzig et al., 2017). For the first five months of 2022, utility-scale solar accounted for more than five percent of Virginia's in-state electricity generation. Solar generation in Virginia more than tripled between 2019 and 2021 (EIA, 2022), and has continued to grow rapidly: Virginia was the fifth-leading state in the country for newly installed solar capacity in 2020 (McGowan, 2021; Vogelsong, 2021) and ranked fourth in 2021 (SEIA, 2022). A June 2022 analysis by the Solar Energy Industries Association (SEIA) estimates that solar developers have invested $4.2 billion in the Commonwealth to date, with more than 35% of that activity occurring in 2021 alone. The benefits of these investments in carbon-free solar development will continue accruing to localities over time as they receive tax revenues from operational utility-scale solar facilities.

As of July 2022, federal data indicated that at least 63 large-scale solar facilities operated in Virginia. Of these, 55 facilities had a rated capacity of five MW or greater—a 44.7% increase in operating utility-scale solar facilities from January 2021 (EIA, 2022; Berryhill, 2021). PJM, EIA, and DEQ data indicate that at least twenty additional utility-scale projects have received a PBR and are planned for installation, under construction, or active but not yet producing power as of July 2022, with many other proposals engaged in local permitting and PBR review processes.

Figure 1 – Operational Utility-Scale Solar Facilities in the Commonwealth of Virginia, as of July 2022[2]

Facility Name	MW	Locality	Service Date (year)
Eastern Shore Solar, LLC	80	Accomack	2016
Pamplin Solar, LLC	15.7	Appomattox	2020
Buckingham Solar LLC	19.8	Buckingham	2017
Buckingham II Solar	20	Buckingham	2021
Altavista Solar	80	Campbell	2021
Depot Solar	15	Campbell	2022
Skipjack Solar	175	Charles City County	2022
Twitty's Creek Solar, LLC	13.8	Charlotte	2020
Caden Energix Hickory LLC	32	Chesapeake	2020
Bedford Solar Center	70	Chesapeake	2021
Grassfield Solar	20	Chesapeake	2022
Hecate Energy Clarke County, LLC	10	Clarke	2017
Essex Solar Center, LLC	20	Essex	2017
Remington Solar Facility	20	Fauquier	2017
Palmer Solar Center	5	Fluvanna	2017
Gloucester Solar, LLC	19.9	Gloucester	2019
Martin Solar Center	5	Goochland	2017
Sadler Solar	100	Greensville	2021
Greensville County Solar Project	80	Greensville	2020
Water Strider (Stagecoach) Solar	80	Halifax	2021
Mechanicsville Solar, LLC	25	Hanover	2020

Facility Name	MW	Locality	Service Date (year)
Desper / Belcher Solar	88.2	Louisa	2021
Grasshopper Solar	80	Mecklenburg	2020
Bluestone Farm Solar	49.9	Mecklenburg	2021
Puller Solar	15	Middlesex	2018
Correctional Solar, LLC	20	New Kent	2017
Hecate Energy Cherrydale, LLC	20	Northampton	2017
TPE Kentuck Solar LLC	6	Pittsylvania	2018
Amazon Solar - Whitehorn Solar	50	Pittsylvania	2021
Danville Farm, LLC	12	Pittsylvania	2020
Irish Road / Whitmell Solar	10	Pittsylvania	2020
Scott I Solar Farm	17	Powhatan	2016
Scott-II Solar LLC	20	Powhatan	2017
Caden Energix Rives Road LLC	19.7	Prince George	2020
Fort Powhatan Solar	150	Prince George	2022
Mt. Jackson Solar I, LLC	15.7	Shenandoah	2021
Southampton Solar, LLC	100	Southampton	2017
Spotsylvania Solar	500	Spotsylvania	2020
TWE Myrtle Solar Farm, LLC	15	Suffolk	2020
Colonial Trail West	142.4	Surry	2019
Spring Grove I	97.9	Surry	2020
Sussex Drive, LLC	20	Sussex	2017

[2] *Author's Note:* The most recent U.S. EIA Monthly Electric Generator Inventory can be located at the following link: https://www.eia.gov/electricity/data/eia860m/

Facility Name	MW	Locality	Service Date (year)
Briel Farm Solar	20	Henrico	2021
Energix Leatherwood, LLC	20	Henry	2021
Woodland Solar Farm	19	Isle of Wight	2016
Rochambeau Solar	19.9	James City County	2021
Hollyfield	17	King William	2018
Hollyfield II Solar	13	King William	2021
Whitehouse Solar Farm	20	Louisa	2016

Facility Name	MW	Locality	Service Date (year)
Oceana Solar	17.6	Virginia Beach	2017
Westmoreland County Solar Project	19.9	Westmoreland	2021
Montross Solar	20	Westmoreland	2018
Gardy's Mill Solar	14	Westmoreland	2020
Woodbine Road Solar	20	Westmoreland	2021
Wytheville Solar	20	Wythe	2022

Source: U.S. EIA Monthly Electric Generator Inventory, PJM Interconnection Queue, Virginia DEQ

The median nameplate capacity for Virginia's active utility-scale solar projects is 20.0 MW. Most of Virginia's operating large-scale solar facilities are in the twelve to fifty MW range, with three out of every four facilities generating twenty-five or fewer megawatts of electricity. Solar projects that are "extremely" large by comparison are at times approved in phases: Spotsylvania Solar, for example, comprises four land parcels with separate project names and SCC Certificate Numbers. Hollyfield I and II, Buckingham I and II, and Scott I and II, respectively, fall in the thirteen to twenty MW range. Phased approvals for large projects are not necessarily the precedent: Some large facilities, such as the 800 MW Randolph Solar Project, have been approved under a single application.

Figure 2 – Large-Scale Solar Capacity by Operating Year, as of July 2022[3]

Year in Service	1 MW to < 2MW	2 MW to < 5 MW	5 MW to < 20 MW	20 MW to < 50 MW	50 MW to < 70 MW	70 MW to < 100 MW	100 MW and greater	Total
2016	1	1	2	1		1		6
2017		3	5	6			1	15
2018			3	1				4
2019	1		1				1	3
2020		1	7	2		3	1	14
2021	1		4	5	1	4	1	16
2022			1	2			2	4
Total	3	5	23	17	1	8	6	63

Source: U.S. EIA Monthly Electric Generator Inventory

[3] *Author's Note:* Due to the lack of state and federal data, the total number of large-scale solar facilities may be an undercount. Figures 1 and 2 synthesize the most reliable EIA, PJM, and DEQ data available to date.

REGULATORY FRAMEWORK

The Virginia Clean Economy Act (VCEA) of 2020 created a mandatory renewable energy portfolio standard (RPS) under which the Commonwealth's two publicly regulated utilities, Appalachian Power Company (ApCo)—a subsidiary of American Electric Power (AEP)—and Dominion Energy, shall produce electricity solely from non-carbon-emitting sources by 2050 and 2045, respectively. One key component of the VCEA establishes a goal of 16.1 gigawatts of electricity generation capacity by solar or onshore wind facilities, of which 35% must be provided by third-party power producers in the form of power purchase agreements (PPAs) (Va. Stat. §56-585.5, 2020). To satisfy this capacity target, Dominion Energy and AEP may enter into PPAs and buy renewable energy from a third party operating a solar or wind facility, develop new solar facilities subject to the approval of the State Corporation Commission (SCC), or acquire solar facilities that are operational or under construction from other developers. Before constructing a new solar facility, publicly regulated utilities must obtain a Certificate of Public Convenience and Necessity (CPCN) from the SCC (Va. Stat. §56-265.2, 2017). The state's forecasted energy needs are sufficiently high (Shobe, 2021; PJM, 2022) and its solar industry sufficiently cost effective (Bruggers, 2021) that developers would likely continue to propose and build utility-scale solar facilities at a rapid pace even in the absence of the VCEA targets.

Before developers can construct a utility-scale solar project with a capacity between 5 and 150 MW, they must receive a permit by rule (PBR) from the DEQ or, depending on a publicly regulated utility's involvement and the developers' own preferences, they may instead file for an SCC permit (20VAC5-302-20). Developers' PBR applications must include an air quality analysis, assessments of cultural, wildlife, and natural heritage resources, a site and context map, a public comment period, and a certification of local government approval (9VAC-15-60-30:120). Solar energy sites with a capacity less than five MW and occupying between two and ten acres undergo a less intensive approval process known as "Section 130" (9VAC-15-60-130).

The Code of Virginia governs utility-scale solar PV system siting and decommissioning through multiple provisions, chiefly Sections 15.2-2316.6:2316.9, 15.2-2232, 15.2-2241.2, and 15.2-2288.7:2288.8. Sections 15.2-2316.6:2316.9 of the Code of Virginia authorize localities to enter into siting agreements for solar facilities with a capacity greater than five MW and describe the required procedure for negotiating and signing such agreements. Section 15.2-2232 describes the contexts in which a locality must deem a proposed solar facility substantially in accord with its comprehensive plan. Section 15.2-2241.2 defines "decommissioning" and states the minimum requirements of a written decommissioning agreement into which a solar facility's owner, land-lessee, or land-developer must enter with the locality. Sections 15.2-2288.7:2288.8 outline zoning permissions and special exception requirements for roof-mounted and ground-mounted solar development.

Virginia House Bill 206 (2022) establishes land management measures for solar facilities on forested lands and USDA-designated prime agricultural soils. HB 206 will affect the future siting of utility-scale solar projects (Holmes, 2022; Lerch, 2022). It remains unclear whether HB 206 will have decommissioning implications for solar energy projects for which an interconnection request is not

received by December 31, 2024 (Va. Stat. § 10.1-1197.6; Weaver, 2022). As of August 2022, regulations pursuant to HB 206 remain under development.

Summary of State Laws Indicating Mandatory and Discretionary Local Actions upon Utility-Scale Solar Facilities

A locality **must:**

- Receive a written notice from a prospective solar developer that discloses their intentions to site a facility with a capacity greater than 5 MW within the locality (Va. Stat. §15.2.-2316.7).
- Either as part of its local legislative approval process or as a condition of approving a site plan, require the owner, lessee, or developer of the land on which a solar facility would be constructed to enter into a written agreement to decommission solar energy equipment, facilities, and devices. This written agreement **must** include the following terms (Va. Stat. §15.2.-2241.2):
  - If the party that enters into such written agreement with the locality defaults in its decommissioning obligation, the locality has the right to enter the real property of the record title owner of such property without further consent of such owner and to engage in decommissioning.
  - Such owner, lessee, or developer must provide financial assurance of such performance to the locality in the form of certified funds, cash escrow, bond, letter of credit, or parent guarantee, based upon an estimate of a professional engineer licensed in the Commonwealth, who is engaged by the applicant, with experience in preparing decommissioning estimates and approved by the locality.
  - The locality cannot enforce a decommissioning cost estimate in excess of the projected cost of decommissioning calculated by a Virginia-licensed engineer.
- Observe the Commonwealth's minimum definition of "decommission": "The removal and proper disposal of solar energy equipment, facilities, or devices on real property that has been deemed by the locality to be subject to §15.2.-2232 and therefore subject to [§15.2.-2241.2]. "Decommission" includes the reasonable restoration of the real property upon which such solar equipment, facilities, or devices are located, including (i) soil stabilization and (ii) revegetation of the ground cover of the real property disturbed by the installation of such equipment, facilities, or devices" (Va. Stat. §15.2.-2241.2).
- Formally approve any negotiated siting agreement for a solar project via a majority of a quorum vote among the local governing body. A locality does not have to negotiate a siting agreement in order to approve a solar project (Va. Stat. §15.2.-2316.7).

- If the locality proceeds with a siting agreement, it must:
  - Schedule a public hearing once the locality's governing body and the facility applicant agree on the terms and conditions of the siting agreement, prior to voting to approve the siting agreement (Va. Stat. §15.2.-2316.8).
  - Enforce the signed siting agreement (Va. Stat. §15.2.-2316.8) and its existing ordinances and regulations, to the extent that they are not inconsistent with the siting agreement's terms and conditions (Va. Stat. §15.2.-2316.9).
  - Recognize that by signing a siting agreement, the locality deems the solar project substantially in accord with its comprehensive plan (Va. Stat. §15.2.-2316.9).

- If the locality chooses to create a local ordinance addressing the siting of solar facilities that generate electricity, the solar ordinance must:
  - Be consistent with the provisions of the Commonwealth Clean Energy Policy (Va. Stat. § 45.2-1708).
  - Provide reasonable criteria to be addressed in the siting of the facility. These criteria shall provide for the locality's protection in a manner consistent with the Commonwealth's goals to promote the generation of energy from solar and wind resources (Va. Stat. § 45.2-1708).
  - Include provisions establishing reasonable siting requirements, and must include provisions limiting noise, requiring buffer areas and setbacks, and addressing the generating facility's decommissioning (Va. Stat. § 45.2-1708).

A locality is authorized to enforce the following **at its discretion:**

- A siting agreement created by the locality may include guidance or requirements including but not limited to mitigation of the solar facility's impacts on the site, financial compensation to the host locality based on specific capital needs, and the solar developer's assistance in deploying broadband (Va. Stat. §15.2.-2316.7).

- Hire and pay consultants in matters pertaining to the solar facility's siting (Va. Stat. §15.2.-2316.8).

- Meet, discuss, negotiate, and enter a siting agreement with the applicant (Va. Stat. §15.2.-2316.8).

- Allow the net salvage value of the solar project's equipment, facilities, or devices to be subtracted from the gross decommissioning cost (Va. Stat. §15.2.-2241.2).

- Allow the decommissioning cost estimate to factor (i.e., add) a reasonable allowance for estimated administrative costs related to a default of the owner, lessee, or developer, and an annual inflation factor (Va. Stat. §15.2.-2241.2).

- Create a local ordinance regulating the disposal of removed solar panels, in accordance with

other applicable laws and regulations affecting their disposal (Va. Stat. §15.2.-2288.7).

- Create a local ordinance addressing the siting of renewable energy facilities that generate electricity from wind or solar resources (Va. Stat. § 45.2-1708).

DECOMMISSIONING ORDINANCE

WHERE TO STATE DECOMMISSIONING REQUIREMENTS

A locality may formally state its decommissioning requirements via a:

- universally applicable zoning ordinance
- conditional use permit (CUP)
- special use permit (SUP)
- special exception (SEP)
- negotiated siting agreement

It may also wish to apply some combination of the above. Some localities, for example, state their guiding minimum decommissioning requirements in a zoning ordinance, and note any further conditions in subsequent site-specific permits.

As of July 2022, just over twenty-five percent of Virginia's 133 counties and cities have codified utility-scale solar decommissioning requirements in a zoning ordinance. The use of locally-codified decommissioning ordinances is nearly twice as high among the Commonwealth's thirty-seven localities with at least one operating utility-scale solar facility. Creating a zoning ordinance for decommissioning offers the locality a guiding document when considering whether to accept a proposed solar project. Codifying minimum decommissioning requirements in a zoning ordinance also helps developers more accurately evaluate costs early in the siting process. A zoning ordinance may be of further benefit to localities in cases where the host locality wishes to implement land-management practices concurrent with the project or land restoration measures after the project terminates.

A locality's comprehensive plan indicates preferences and priorities for land-use, as well as the county's or city's values and strategic goals. Localities generally verify that any discretionary decommissioning requirements are in accordance with their comprehensive plan, which may contain related goals such as renewable energy development, economic growth, or technological progress.

REFURBISHMENT AND REPOWERING

The construction of a solar installation generally requires costly, up-front site improvements whose value may extend beyond the life of the solar panels initially installed at the site. These improvements include site preparation and the infrastructure for connecting the facility to the grid. Because these infrastructure assets will continue to have value even as the original panels age, solar developers will often find it advantageous to repower an existing site by installing new panels and using the already developed land and power improvements. Given the likely advantages of a future repowering, developers and localities may find it advantageous to address the refurbishing or

repowering of EoL facilities in either the locality's zoning ordinances or permit process language. Thus, in addition to requiring that operators maintain a decommissioning plan, localities could state any preliminary conditions for re-permitting the land use of the facility at the end of the initial expected life of the facility. Re-permitting can be valuable to both developers and localities, since the repowered facility can have substantially lower costs. Note that a locality's renegotiation of its permission for a facility owner to continue using a parcel of real property for electricity generation is entirely different from any financial agreements between the power producer and off-taker as negotiated in a PPA, which does not involve the locality.

A locality may use a permit or siting agreement to enumerate the minimum conditions a facility's owner or affiliate should fulfill if they seek to repower the site at the project's end (Wyatt, 2020). Relevant permit language may be as simple as an extension clause. Examples from locally approved utility-scale solar sites in Virginia include:

- "The expected life of the Project is thirty (30) years with extension possible upon mutual agreement with the landowners ("Project Life")." (Conditional Use Permit Approval for Eastern Shore Solar, 80 MW; Accomack County)
- "The expected useful life of the Solar Farm Project is twenty-five (25) to thirty (30) years with an extension possible upon mutual agreement with the landowners (the "Project Life")." (Conditional Use Permit Approval for SunTec Solar Farm, 20 MW; Accomack County)
- "The Owner reserves the right to extend the Project instead of decommissioning at the end [sic] commercial operations with landowner permission and upon obtaining all necessary permits. If the Owner seeks to extend the life of the Project, they will decide whether to continue operation with existing equipment or to retrofit solar panels and power system with upgrades based on new technologies." (Special Use Permit Application for Caden Energix Gladys, LLC, 60 MW; Campbell County)
- "If the Solar Facility is operated for greater than 35 years after the Agreement Date and after the Termination Date, the Developer will use reasonable efforts to negotiate an extension of this Agreement with the County." (Siting Agreement for Randolph Solar Project, 800 MW; Charlotte County)
- "The expected life of the Project is thirty (30) years with possible extension ("Project Life")." (Conditional Use Permit Approval for Southampton Solar, 100 MW; Southampton County)
- "The facility has an estimated useful life of at least 35 years with an opportunity for extension depending on equipment replacements or refurbishments." (Special Exception Permit Approval for Montross Solar, 20 MW; Westmoreland County)

RECOMMENDED DECOMMISSIONING ORDINANCE CONTENT

A decommissioning ordinance typically states the decommissioning procedure a locality requires the site owner or operator to follow and specifies the appropriate contents of the decommissioning plan a developer must file with the locality before constructing the facility or receiving site approval. It also defines relevant legal terms and conditions and describes the minimum acceptable standards for land restoration. While Virginia law requires developers[4] to enter into a decommissioning agreement with their host locality, it does not mandate that localities develop a zoning ordinance stating decommissioning requirements. If a locality does not wish to codify specific decommissioning standards or the rights of the local governing body over the decommissioning process in its local laws, it may still find it beneficial to state them in its decommissioning agreement with the project owner.

Procedure

A decommissioning ordinance should state the conditions under which the facility's owner must initiate decommissioning; namely, site abandonment or the end of the project's life, and the time constraints by which decommissioning must be fully executed.

Prior to the cessation of operations, a locality may require the project owner to submit a written notification that a site has reached the end of its project life, shall be non-operational, or is scheduled to be abandoned to the relevant government official, such as the zoning administrator, county administrator, county building official, or zoning and inspections director.

At its discretion, the locality may further establish a procedure for setting the official timetable for decommissioning. Some Virginia localities, for example, have codified their right to issue a site-specific "County Notice" or "City Notice" (hereafter, "Notice") that the locality deems the facility deactivated or abandoned and requires decommissioning to be fully executed within a set period of time from the owner's receipt of the Notice. Others specify that upon their receipt of the project owner's notice of non-operationality, or upon a zoning administrator's subsequent site inspection and confirmation that it would be timely and appropriate to initiate decommissioning, the site must be fully decommissioned within twelve to twenty-four months.

Localities may reserve the right to issue a Notice if a site fulfills the criteria which would qualify it as abandoned or deactivated even if the facility's owner or operator has not submitted a written notification of the site's non-operationality. It is considered good practice to allow a window for the owner or operator to appeal for approval to repair a non-operational site that has not reached the end of its project life upon receiving a Notice. Should the need arise, a locality may also choose to allow its relevant local governing body, such as its Board of Supervisors, to grant a decommissioning extension or extensions.

Terms and Conditions

Decommissioning: Localities generally define "decommissioning" as the removal and proper disposal of all above-ground hardware, structures, and solar infrastructure along with removal of part or all below-ground equipment upon a project's abandonment, termination, or after its anticipated useful life, in accordance with the decommissioning plan submitted to and approved by the locality. Such a definition is consistent with that provided in §15.2-2241.2 of the Code of Virginia. Based on NREL guidance and definitions implemented by localities in Virginia and other states, an appropriate decommissioning specification may also include the reclamation of access roads and the restoration of the land and related disturbed areas to agreed-upon conditions for subsequent use via soil decompaction, soil stabilization, re-seeding, or revegetation. Based on site characteristics, it may be necessary to delay the removal of any stormwater structures which should remain in-place during the hardware removal and land restoration phases. In some cases, a locality may deem that certain installations, such as stormwater structures or access roads, constitute real improvements to the site based on its future land-use, and allow such installations to be exempted from decommissioning.

Abandonment, Deactivation, and End of Life: Virginia localities with abandonment or deactivation clauses in their decommissioning ordinances typically identify a solar facility as abandoned if it ceases to generate electricity for a continuous period of twelve months, with some localities' definitions ranging between six and twenty-four months. To protect against abandonment in the construction phase, localities may also include language quantifying the number of months a developer has to reach an operational status before the conditional use permit must be renegotiated. For example, a locality may specify that a solar facility shall held as abandoned if construction on an initiated project remains incomplete twenty-four months after the locality has approved the final site plan, with exceptions granted for interconnection delays due to the rolling backlog of requests in the PJM queue. To avoid legal ambiguity, it is crucial that a decommissioning ordinance clearly distinguish between the conditions of inactivity which constitute abandonment and those that do not. These conditions are covered in greater detail in the "Legal Framework" section of this paper.

Financial Considerations: A decommissioning ordinance will generally state which forms of posted financial assurance the locality considers acceptable and should specify that financial assurance must cover the full cost of decommissioning. It may allow, explicitly disallow, or remain silent on whether a developer may factor part or all of hardware's anticipated salvage value into the estimated net cost of decommissioning. To guard against abandonment or financial insolvency early in the project, a locality may require a developer to provide proof of liability insurance for the solar facility before initiating construction.

Rights of the Locality Regarding the Project Site: The locality should specify its right to enter and remove the facility if decommissioning protocols have been activated but the owner or operator has failed to fulfill them within a timely manner. Legal actions and remedies available to the locality in such a case are further described in the "Procedural Framework" section of this paper. A locality may require that it be granted the right to periodically enter and inspect the solar facility during decommissioning. It may also wish to specify a framework by which the site owner or operator should coordinate with local emergency services to train for responses to onsite emergencies, provide site access, and develop an Emergency Operations Plan throughout the facility's operational period.

Land Management and Restoration

Land management requirements for a utility-scale solar site are more often specified in a siting agreement or local land use permit rather than in a decommissioning ordinance. Even so, it is appropriate for a decommissioning ordinance to state that a facility owner or operator must comply with state and federal regulations for sediment and erosion control during site construction, operation, and decommissioning. Because Virginia state law allows localities to enact sediment erosion and control standards that are more stringent than those mandated by the state (Va. Stat. §62.1-44.15:51), it may be prudent to reference any such regulations in the decommissioning ordinance. Measures for protecting wetlands during decommissioning and maintaining watershed nutrient load standards when amending soil should be similarly noted, where applicable and necessary. Land restoration may include such measures as soil regrading, the application of soil amendments, reseeding, revegetation, and the removal of all access roads and internal paths, or those deemed relevant. It may also be necessary to re-grade, backfill, and re-stabilize areas significantly impacted by the removal of any site components. The de-compaction of both topsoil and subsoil horizons may be necessary as agreed to by the landowner, consistent with the future use of the land or as required by then-current state laws and regulations.

The heavy machinery used to install and dismantle utility-scale solar PV systems can compact topsoil and subsoil across the disturbed land area. While amending these soils with organic fertilizers and replanting with native vegetation to the extent feasible[5] during and after the solar project's life are excellent land management and restoration practices (Horowitz, Ramasamy, Macknick, & Margolis, 2020; Walston et al., 2018), replanting alone will not reduce the bulk density of compacted soils beyond a few inches over twenty to thirty years. Deep-rooted plants such as alfalfa and switchgrass and chemical amendments such as gypsum may increase land productivity over time, but they cannot in themselves loosen highly compacted topsoils and subsoils. If agriculture is the desired

[5]*Author's Note:* Depending on site characteristics, it may be quite challenging to maintain native vegetation directly around active panel displays because of (1) the mowing standards by which a project owner must abide to fulfill safety and access requirements and (2) short- and medium-term erosion and sediment control measures (L. Daniels, personal communication, August 1, 2022). Native vegetation is encouraged where practicable.

post-project land use, the locality should require the party responsible for decommissioning to mechanically loosen and till the soil prior to revegetation.

Where decompaction is necessary, it is crucial that tillage is applied under the appropriate soil-moisture regime, as ascertained by the site engineer. Overly dry soil will prevent the shank used for tillage from cutting through the ground, and may cause a chisel plow, rototiller, or shank ripper to eject large chunks of intact soil. Conversely, a shank will pass too smoothly through overly wet ground and fail to shatter compact soil. The extent of tillage necessary will vary site-to-site and can be easily determined by measuring the bulk density and texture of the upper inches of soil and generating an estimate of the root-limiting bulk density, which is well-established in agronomic literature. If possible, topsoil should be salvaged and re-applied in a loose, rough, and undulating manner after tillage or cut-and-fill measures have been applied. These decompaction and soil reconstruction practices sufficiently restore property for silviculture or hay-land pasture use, but for USDA NRCS-designated prime farmland, NRCS prime farmland and state-designated "important agricultural soils", additional measures may be required to restore the land to its prior productivity (L. Daniels, personal communication, July 5, 2022).

Decommissioning Plan

The decommissioning plan is typically submitted for review concurrent with a solar facility's site plan. A locality's Planning Commission should review the decommissioning plan no less frequently than once every five years after its initial approval. Based on guidance from existing decommissioning plans, the North Carolina Department of Environmental Quality (2022, p. 12), and the Virginia-based developer SolUnesco (Maamari, 2018), a decommissioning plan should contain:

- **Contact information** for the landowner, site operator, and entity responsible for decommissioning. This information should include the relevant parties' names, titles, physical mailing addresses, email addresses, and business names.
- The **anticipated project life**, along with the current land-use (e.g., industry, agriculture, silviculture) and the proposed land use (i.e., utility-scale solar development).
- A **cost estimate** for decommissioning including the anticipated present value, an explanation of the cost calculation applied, and a description of the financial assurance to be posted for decommissioning that has been deemed acceptable by the locality's relevant legal authority, such as the County Attorney, including which legal entity shall establish the surety, when it shall be established, and how the locality shall access it should the need arise.

- A **decommissioning narrative** describing the procedure through which decommissioning will occur, a schedule for this procedure which includes the total estimated length and the estimated duration of each activity, the disposal methods which shall be applied (e.g., hazardous waste vs. non-hazardous waste disposal, landfilling, reuse, recycling) in accordance with then-current state and federal regulations, and a description of the expected site conditions once solar facilities have been removed.
- A **salvage plan** describing the procedures by which equipment will be recycled or resold in licensed secondary markets, where possible.
- A **restoration plan** detailing the quality to which the land will be returned and the actions necessary to accomplish this.

Current decommissioning plans in Virginia generally describe the full removal of above ground support structures, as well as below ground piles where practical. Removable hardware includes but is not limited to solar panels, panel trackers, anchors, supports and mounts, inverter buildings, electrical conductors, electrical cables, substation components, control cabinets, and fencing. Below-ground components must usually be removed to thirty-six inches below finished grade or down to bedrock, whichever is less. For a below-ground component such as a steel piling extending deeper than thirty-six inches, the owner would be obligated to remove at least the upper portion of the piling. In practice, because the piling is a single component, facility owners will remove the full module. In the event that a sub-surface component breaks during removal, is embedded in bedrock, or cannot otherwise be recovered, existing special use permits specify that the piece should be excavated to a depth of at least thirty-six inches, with the remainder left in place and covered with an appropriately-reconstructed soil profile (SolUnesco, 2018; L. Daniels, personal communication, August 1, 2022). Some local governments allow a subsurface component to remain if the landowner submits a written request for a waiver to the relevant local legislative body.

Solar waste should be recycled to the maximum extent feasible where such markets exist. While current research indicates that solar recycling is generally unprofitable in comparison to landfilling and without additional legislative protections (D'Adamo, Miliacca, & Rosa, 2017; Malandrino et al., 2017; Lunardi et al., 2021), several European solar recycling paradigms have been shown to be cost effective (Choi & Fthenakis, 2010; McDonald & Pearce, 2010) and impressive progress has been made in designing full-module recycling systems (Klugmann-Radziemsa, 2012; Cucchiella, D'Adamo, & Rosa, 2015; Latunussa, Ardente, Blengini, & Mancini, 2016; Heath et al., 2018; Faircloth et al., 2019; Markert, Celik, & Apul, 2020; Peacock, 2021; Flores et al., 2022). Because comparable solar waste markets, collection systems, and recycling facilities have not yet been realized in the mid-Atlantic United States (Ovaitt, Mirletz, Seetharam, & Barnes, 2021), decommissioning ordinance clauses which recommend solar recycling are beneficial but not enforceable. Recent guidance from the North

North Carolina DEQ to its state's localities hosting utility-scale solar projects encourages the economic development of recycling and reuse streams for end-of-life solar panels (Scott, 2022).

Based on the federal government's Resource Conservation and Recovery Act of 1976 (RCRA), solar panels and system components which qualify as recyclable material may also be subject to regulations for solid waste or potentially hazardous waste, depending on the content of the PV module (40 C.F.R. §§ 261.2(a)-(c); 42 U.S.C. § 6903(27); 40 C.F.R. § 261.2(e)(ii)). For example, one square meter of a thin-film cadmium telluride (CdTe) photovoltaic module contains about seven grams of cadmium—about as much as a 4.6 cubic inch nickel cadmium (NiCd) flashlight battery (note also that NiCd, being subject to the EPA's Universal Waste Rule, is best disposed of via recycling) (Zweibel, Moskowitz, & Fthenakis, 1998, pp. 1-2; Industrial Economics, 2004, p. 23). Research conducted by the National Renewable Energy Laboratory suggests that the primary federally approved method for testing solar panel toxicity, the Toxicity Characteristic Leaching Procedure (40 C.F.R. §§ 261.11, 261.24) has variable results depending on the sampling location, removal method applied, and laboratory used to analyze results (Curtis et al., 2021, p. 8; TamizhMani et al., 2018). The EPA recommends the appropriate recycling or reuse of hazardous materials to reduce soil pollution and the consumption of primary resources (EPA, 2021); thus, the activation of an RCRA or TCLP hazardous waste designation should be understood as ensuring responsible waste management rather than threatening environmental quality. If desired, a locality may adopt regulations into their zoning ordinances that installed panels meet internationally recognized standards of material quality. Such PV modules will still likely fall under RCRA's purview. Any hazardous materials should be removed and disposed of in accordance with then-current local, state, and federal regulations. When solar hardware is recycled, resold in a licensed secondary market, or otherwise appropriately disposed of, it is good practice for a developer to retain the manifests provided by such sites which document the quantities and descriptions of the delivered materials. Localities seeking additional guidance on PV material management may consider reviewing the standards required in Washington, California, New Jersey, and North Carolina (NYSERDA, 2022).

LEGAL FRAMEWORK FOR LOCALITY IN CASE OF ABANDONMENT

Non-financial mechanisms can assure PV system decommissioning by defining a legal framework which indemnifies the locality in the event of abandonment. These mechanisms often resemble the regulations applied to ensure the decommissioning of telecommunications installations. The New York State Energy Research and Development Authority (NYSERDA) identifies these key mechanisms as an abandonment and removal clause, a special permit application, and a temporary variance process.

ABANDONMENT AND REMOVAL CLAUSE

Localities should clearly define non-performance and abandonment and delineate the timeframes by which (i) a project's status is considered "abandoned", (ii) an owner or operator may appeal an abandonment status and/or correct the solar site, and (iii) the locality may access financial assurance in the event that an abandoned project has not been decommissioned in a timely manner. An abandonment and removal clause may outlay the terms for civil penalties and fines levied on the owner or operator of an abandoned site. The locality may further state its ability to impose a lien on such a property to recover decommissioning costs in cases where financial assurance is inaccessible or otherwise insufficient to remove the solar facility. Both "abandonment" and "removal" should be clearly defined to eschew any legal ambiguity. The timeframe allotted for decommissioning an abandoned or end-of-life project should be sensitive to the solar facility's size, location, and complexity.

Localities should also specify the contexts in which it is permissible for a solar site to remain continuously inactive for an extended period without being designated abandoned. An analysis of decommissioning ordinances enacted by Virginia localities indicates that acceptable non-abandonment scenarios may include but are not necessarily limited to:

- A **force majeure event** that has occurred or is occurring, which will prevent the facility from resuming operations within twelve months;
- A project in the process of being **repowered**;
- A project pending completion of construction due to a backlog of cases or service requests in the **PJM interconnection queue**;
- A situation in which the owner or operator can provide evidence to the relevant local governing board, such as the Board of Zoning Appeals or Board of Supervisors, that the site's period of continuous inactivity is due to circumstances **beyond their control** and the facility has not been abandoned; and

- An appeal of the County Notice or City Notice within a set time from its receipt (e.g., 45 days) in which a facility owner explains the reasons for operational difficulty and provides a timetable for **corrective action which the locality deems reasonable.**

SPECIAL PERMIT APPLICATION

In the absence of a solar ordinance that requires a decommissioning plan, a locality may, as a condition of SEP/CUP approval, require the Final Site Plan review to include its approval of a complete and accurate decommissioning plan (NYSERDA, 2022). The locality may also require a conceptual decommissioning plan as a condition of special permit approval, understanding that component-specific details and site design may not be finalized until the Final Site Plan review.

Codifying a decommissioning plan requirement protects the locality's interests in that (i) the locality is authorized to request any significant revisions to the decommissioning plan or procedure before approving the Final Site Plan, and (ii) the local government may apply the approved, complete decommissioning plan as a framework for assessing decommissioning noncompliance at the end of a project's life or in the case of abandonment.

TEMPORARY VARIANCE PROCESS

Issuing a land variance or special or conditional use permit for a utility-scale solar facility allows the locality to exercise its regular zoning enforcement authority to remove an abandoned or otherwise non-operational facility. It further allows the locality to re-license the facility, if desired, once the project term expires (NYSERDA, 2022).

EXAMPLES

Abandonment clauses protecting the locality against bearing decommissioning costs state the point at which the locality may access financial assurance, enter the site without the owner's site to complete decommissioning, or pursue other legal action for failing to decommission the site within the agreed-upon period. Note that while the locality's right to enter a solar facility without the owner's consent and engage in decommissioning is protected under Section 15.2.-2241.2 of the Code of Virginia, it is considered good practice to restate this right in a decommissioning ordinance, siting agreement, and/or condition for land use. Relevant examples from Virginia localities' solar decommissioning ordinances are shown below, with emphasis added:

(a) Legal action and liability statements:

- "…the county **may pursue legal action** to have the facility removed at the expense of the facility owner, site owner, or operator, each of whom shall be **jointly and severally liable** for the expense of removing or repairing the facility." (Appomattox County Code, §19.6-97.6; Halifax

County Code, §53-160; Prince Edward County Code, §7-114)

- "If the owner or operator fails to remove or repair the unsafe solar energy project, [the county] **may pursue a legal action** to have the project removed **at the owner's or operator's expense**." (Dinwiddie County Code, §22-234.68; Henry County Code, §21-1807; Southampton County Code, §18-367)

- "If the facility is not removed within the specified time after the County Notice, the County may cause the removal of the facility **with costs being borne by the project owner**." (Piedmont Environmental Council utility-scale solar development policy draft for Culpeper County, unadopted)

- "The surety shall be **sufficient to indemnify the County** if it incurs costs to rectify any violations of applicable codes, or to remove obsolete or abandoned renewable energy facilities in the event the applicant, its successors or assigns, fails to comply with any condition of the permit, **which the County may undertake** to do if the applicant, its successors or assigns fail to do so within 90 days of notice from the Zoning Administrator of a violation of any provision of this chapter or any of the permit conditions imposed by the Board." (Rappahannock County Code, §170-64)

- "Within three hundred sixty-five (365) days of the date of abandonment or discontinuation, the owner of the system shall physically remove all components of the solar energy facility. If not removed within the allotted time, **the county may have it removed at the expense of the property owner**." (Rockingham County Code, §17-607)

- "If the owner or operator fails to either notify the County Administrator or a designee that the large-scale solar facility is an abandoned large-scale solar facility or to decommission the abandoned large-scale solar facility upon request of the County, the County may, **in addition to any other remedies available under the law, cause the abandoned large-scale solar facility to be decommissioned** and recover against the bond posted pursuant to § 165-174E the costs of such decommissioning." (Shenandoah County Code, §165-174H)

- "If removal to the satisfaction of the county does not occur within one (1) year from the date of abandonment then the county may remove and salvage the component(s) and all supporting equipment using the decommissioning surety. Should the surety fail to adequately fund the decommissioning of the site(s) **the county will recover any difference**, including attorney fees and any zoning violation fines, if applicable, **through legal action against the designated responsible party or parties** identified in the decommissioning plan, applicant, and/or landowner(s) party to the SUP, and their respective successors and assigns." (Spotsylvania County Code, §23.4.5.7)

(b) Entry right statements:

- "If the owner, lessee, or developer defaults in the obligation to decommission the facility, the county has the **right to enter the real property without further need of consent of the owner** to engage in decommissioning." (Alleghany County Code, §66-762; Gloucester County Code, §9-28)

- "If the party that enters into such written agreement with the County defaults in the obligation to decommission such equipment, facilities, or devices in the timeframe set out in such agreement, the County has the **right to enter the real property of the record title owner of such property without further consent of such owner** and to engage in decommissioning." (Campbell County Code, §22-32; Isle of Wight County Code, §5-5003)

- "If the terms of the decommissioning agreement are not met, **the county may collect the surety and may enter the site** to remove the equipment, apparatus, or any other personal property or improvements placed on the real property as a part of, or in connection with, the solar facility as it deems appropriate." (Brunswick County Code, §23-407)

- "If the facility owner/operator fails to remove the installation in accordance with the requirements of this permit or within the proposed date of decommissioning, the County may collect the bond or other surety and the County or hired third party **may enter the property to physically remove the installation**." (Amelia County Code, §325-34.2)

- "In the event the holder of a conditional use permit for a utility solar energy facility breaches the obligations put forth in the written agreement, **the city may utilize the financial assurance, in whole or in part, to enter the property and engage in decommissioning the site without the owner's consent**." (City of Chesapeake Code, §13-2702)

- "If the applicant, its successor, or the property owners fail to decommission the solar energy facility within six (6) months,[6] the County shall have the right, but not the obligation, to commence decommissioning activities and **shall have access to the property,** access to the full amount of the decommissioning surety, and the rights to the solar energy equipment and materials on the property." (Prince George County, draft solar energy facility siting policy, unadopted)

[6] *Author's Note:* Emerging best practice is to allow the facility owner a minimum of twelve months to fulfill all decommissioning requirements.

FINANCIAL ASSURANCE

Whether as part of a decommissioning plan, a zoning ordinance, or a condition of the solar facility's approval, a locality should require the project's owner or affiliate to post financial assurance (FA) equal to the full amount of the estimated decommissioning costs. These costs generally include labor, infrastructure removal and transportation, recycling, disposal, and site restoration and reclamation (Curtis et al., 2021). Localities frequently interchange the term "surety" with "financial assurance". While "surety" technically refers to the person who assumes direct liability for another party's debt or other legal obligation upon the closing of the land-use agreement (Cornell Law School, 2022; Garner, n.d.), substituting the terms "surety" or "surety amount" for FA is an accepted practice.

The amount, type, and posting time(s) of FA will depend on the size, complexity, and duration of operation of the solar facility, as well as the site owner's access to capital; as such, FA varies across utility-scale solar projects. It is standard best practice to require that the surety amount be adjusted at least every five years based on a Virginia-licensed engineer's re-evaluation of decommissioning costs. State law also allows the annual application of an inflation factor to the original decommissioning cost estimate so that the total decommissioning security reflects real market costs. Localities should be aware that removal costs may both fluctuate and can change at different rates than the market rate of inflation. An engineer's regular recalculation of the decommissioning cost estimate may thus provide a more precise estimate of site removal costs than applying an inflation factor would. If decommissioning costs are periodically reassessed, it is redundant to include an inflation factor.

FA should also always be posted until the end of the decommissioning process, regardless of the point at which the locality requires the project owner to begin posting it. As such, a solar decommissioning regulation that contains language resembling the following is encouraged:

- "The full amount of the specified financial assurance must remain in full force and effect until the Project is decommissioned and any necessary site restoration is completed,"
- "At its option, the County / City may require the financial assurance amount change based on the net cost of decommissioning," *and,*
- "In the event of abandonment or failure to decommission, the County / City shall have access to the full amount of the specified financial assurance."

WHAT KINDS OF FINANCIAL ASSURANCE SHOULD A LOCALITY ALLOW?

It is in both the locality's and the project owner's best interest to provide the local government with the necessary security for full decommissioning at the lowest cost to the developer. The most appropriate FA mechanism may change in cases where a solar project comes under new ownership, as the latest holder may have a different level of access to capital (MDOC, 2018, p. 7). While all FA types are capital-intensive, some require considerable expenditures for annual maintenance and may impose undue financial hardship on the facility owner or affiliate. Similarly, others may be inefficient to apply where the developer is a well-established entity with very strong financial backing. Commonly accepted financial assurance mechanisms and the situations in which they may be most useful to a locality are described below. A locality should always require that any third-party financial institutions or bank accounts involved in maintaining and procuring the FA are federally insured.

Trust Funds

Financial institutions employ a Trustee to manage trust funds on behalf of the project's owner. Trust funds may be used alongside additional FA mechanisms, such as a surety bond or letter of credit. A trust fund is both capital-intensive—the developer often must pay all or much of the decommissioning cost into the trust fund at the project's outset, as well as the administrative costs for the Trustee investing and managing the fund—and relatively risky, as the trust fund is susceptible to market volatility. Any return on the invested funds that outpaces general inflation or industry-specific increases in decommissioning costs would reduce capital costs for decommissioning faced by the developer, who may then be able to receive funds in excess of the decommissioning cost. If decommissioning costs rise unexpectedly or the trust fund performs poorly in the investment market to the point that its worth is less than the decommissioning cost estimate, the developer will need to deposit additional payments to true up the security (Richards, n.d.). Thus, the project owner or developer may incur the additional burdens of remaining in contact with the Trustee managing the trust; filing riders or amendments in the Trust Agreement between the solar site and the financial institution and notifying the locality if the Trustee or financial institution changes name or undergoes a merger; constantly monitoring the trust's value; and verifying that administrative fees are not eroding the trust fund's value (EPA, n.d., "RCRA Fact Sheet: Trust Fund"). If the solar project changes ownership, the trust fund will not automatically transfer to the successor company.

Cash Escrow

A solar project owner or developer may deposit funds into a cash escrow account maintained by a federally insured financial institution. Once the project owner fulfills the decommissioning requirements set by the locality at the end of the facility's life, the bank will release the funds deposited in the cash escrow account back to the developer. If the solar project is abandoned or insufficiently decommissioned, the bank will grant the locality access to the cash escrow account to complete the decommissioning process. A locality may require the developer to post full funding for

decommissioning at the beginning of the project's life or according to a fee schedule set in the use permit approval.

While a cash escrow account is relatively simple to administer, it imposes high costs on the facility's owner. Developers with strong credit and capital access are less likely to implement cash escrow as their preferred FA mechanism; in fact, it may be the only surety option available to smaller developers with limited credit access (MDOC, 2018, pp. 8, 30). Similar to the restrictions of a money market account, the funds held in cash escrow remain inaccessible to the solar facility's owner or affiliates for the duration of the project. Prior research suggests cash escrow accounts are sufficiently costly to utility-scale solar developers that, if a locality requires cash escrow but disallows salvage value, a developer is likely to withdraw the project altogether (Maamari, 2018). Thus, localities stipulating cash escrow as a financial assurance mechanism should (i) establish a preset schedule of deposits to the account, so the project owner does not bear decommissioning assurance as an upfront cost, and (ii) include a salvage credit so account maintenance costs are not prohibitively high early in the project life.

Letter of Credit

A letter of credit (LC) is a federally insured financial institution's legally-binding written guarantee that it will pay a beneficiary—here, the locality—under specified conditions, such as if the developer defaults on decommissioning or abandons the solar project, until the LC's expiration date, usually one year from issuance (U.C.C. § 5-103(a), 1995), unless the developer renews the LC annually. For the term that the LC exists, the issuing bank may impose an unsecured credit pool (UCP) lien or Uniform Commercial Code (UCC) lien on the solar developer equaling the amount of the LC. The LC thus appears as a footnote on the solar company's balance sheet indicating its future decommissioning liability and may impact the company's ability to access credit markets (Freeman, 2020). Should the solar company fail to decommission the project in accordance with the terms of its contract with the locality, the locality will receive sufficient decommissioning funds from the issuing bank. The solar company must then reimburse the issuing bank for any payments to the locality.

A financial institution will typically require a solar company seeking a letter of credit to post collateral—cash or non-cash—equaling between 0.5% and 1% of the LC's face value, and to establish a standby trust fund from which the bank would pay for decommissioning and land restoration activities. The letter of credit and standby trust fund may be issued by different financial institutions. The LC's issuing and maintenance costs vary with the solar developer's or owning firm's creditworthiness: annual renewal fees range from one percent to five percent of the letter of credit's face value (MDOC, 2018; Richards, n.d.), and can thus become quite costly. For example, if a bank's renewal fee is 3% per annum on an LC with a $435,000 payout, the project owner would need to pay more than $13,000 annually simply to maintain the surety amount. Despite these conditions—collateral, renewal fees, and the establishment of a standby trust fund—letters of credit may be

relatively less expensive than posting cash escrow, even for less financially solvent developers. Moreover, because a letter of credit is publicly filed, a locality can verify its value more easily than it can a cash escrow account (Nusgart, 1998).

If a locality allows decommissioning security to take the form of a letter of credit, it should (i) specify an irrevocable LC, (ii) include an evergreen clause, and, as in all cases, (iii) abide by the typical precautions associated with storing and implementing a legally binding financial document. While an irrevocable LC cannot be revoked or conditionally altered by the bank or the project owner, the payout amount guaranteed by the LC should accurately reflect changes in the estimated cost of decommissioning. If decommissioning costs significantly increase or decrease, adjustments in the payout promised by the irrevocable LC can only occur with the explicit agreement of the project owner, the beneficiary, and the issuing bank. Requiring an irrevocable LC thus ensures that no changes can be made to the decommissioning security without the locality's knowledge and consent. Requiring that an LC have an evergreen clause causing the FA's automatic annual renewal offers further assurance to the locality in that its access to decommissioning surety from the LC's original signing is not compromised. Because the solar company would already need to maintain the LC year-to-year, an evergreen clause poses no unanticipated financial burden on the developer. Finally, since the LC is a cash instrument, the issuing bank's liability is strictly enforceable (Downey, 1988, p. 6): The locality can access the standby trust fund only upon presenting the original, signed LC and any other documents required by the financial institution. As such, the locality should maintain the original LC in a secure location inaccessible to the public (EPA, n.d., "RCRA Fact Sheet: Letter of Credit").

Surety Bond Guaranteeing Payment or Performance

In a surety bond agreement, the Surety—a third-party insurer such as a bank insurance company—agrees to complete decommissioning or uphold the project developer's financial obligations for the landowner's or locality's benefit if the developer defaults, abandons the project, or otherwise fails to decommission the solar facility (Garner, n.d.; Curtis et al., 2021). To access the surety bond, a locality typically must notify the Surety that the solar company, or Principal, failed to decommission the site. After verifying the locality's claim, the Surety will pay decommissioning funds into a standby trust fund for the locality's use. The Principal must reimburse the Surety for any outstanding decommissioning costs.

Different types of decommissioning surety bond exist, the most common being a payment or financial guarantee bond. Bond companies will less frequently extend a performance bond, which largely resembles a payment bond in structure and execution except that the Surety may decide whether to put an activated decommissioning bond in a standby trust fund or use the bond to hire contractors and carry out the decommissioning requirements itself (Richards, n.d.). A solar project owner cannot combine a performance bond with other financial assurance mechanisms, but a payment bond or

financial guarantee bond can be used in conjunction with other FA options. All surety bond types are generally paid into a standby trust fund if the locality informs the bond company that the project owner has failed to decommission (EPA, n.d., "RCRA Fact Sheet: Surety Bond").

To obtain and maintain a surety bond, the Principal must pay the bond company an annual premium equaling a percentage of the decommissioning bond amount (MDOC, 2018; Maamari, 2018). This annual premium usually ranges from 1 to 3% of the decommissioning bond's face value; of course, if a developer has poor credit or the bank assesses a solar project as relatively riskier, the bond premium could rise as high as 15% (Freeman, 2020). Although circumstances vary across projects, surety bonds do not have the same credit rating implications as letters of credit and may thus be relatively less costly for a developer while still providing the same level of decommissioning security to a locality.

Insurance

A solar company may take out a fully-funded or "finite" insurance policy equaling the net present value of its expected decommissioning liability. It pays this liability amount either through a single up-front insurance premium, or in phases of premiums paid during some portion or all of the solar project's life. As a result, the solar company pays for decommissioning twice: Once through the insurance policy, and again upon actual decommissioning. The locality may then direct the insurer to reimburse the solar company for incurred decommissioning costs once the removal and restoration terms have been fulfilled (Richards, n.d.).

Another insurance mechanism, a risk transfer policy, moves the solar company's decommissioning liability to the insurer through the company's payment of a premium to the insurer throughout the project's life (EPA, n.d., "RCRA Fact Sheet: Insurance"). Risk transfer policies more commonly occur in oil and gas decommissioning projects, for which temporal uncertainties regarding a project's life and unknown total liabilities during and after closure could cause the project owner or operator to fail to perform decommissioning due to financial distress (Barnes, 2018). Solar decommissioning is far more straightforward: the process is less costly, the project life is pre-negotiated, the facility is relatively smaller, hardware removal has few engineering and environmental complexities, and land restoration requirements can be fulfilled within weeks to months. A risk transfer policy is not inappropriate in a solar decommissioning context, but insurers may prefer underwriting fully-funded insurance policies, which more effectively limit the insurer's risk exposure (EPA, n.d., "RCRA Fact Sheet: Insurance").

Despite their expense, insurance policies offer some flexibility: They do not require the establishment of a standby trust fund and can be paired with additional financial assurance mechanisms. If decommissioning costs change, the solar company can alter the policy's face value relatively easily. For increases in the decommissioning cost estimate, the company could also pair the insurance policy with another locality-approved FA mechanism.

A locality allowing decommissioning insurance should structure necessary requirements of the policy among the decommissioning conditions of the use permit, and should exercise due diligence by monitoring an active policy. Similar to other FA mechanisms, the insurance policy would fail to hold in the event of decommissioning default if the insurer canceled the policy or became bankrupt. By design, an insurer can only cancel a policy if the company fails to pay its premium. Thus, the locality should monitor both the insurer's financial solvency and that the solar company pays all its premiums. Any insurance policies for decommissioning should be subject to the locality's approval. Based on an overview of existing utility-scale solar ordinances in Virginia and an analysis of the EPA's recommendations for closure and post-closure insurance, a locality accepting decommissioning insurance should require the following conditions to hold:

- The insurance policy should contain a provision transferring the policy to the successive owner or operator of the solar facility if it is sold by the original policyholder;
- The insurer cannot cancel, terminate, or fail to renew the policy except for failure to pay the premium;
- The policyholder must send a notice of cancellation to the relevant local/state authorities upon failure to pay the premium; and
- If the insurer cancels the policy, the owner or operator must obtain an alternate form of financial assurance, subject to approval by the locality.

The locality may specify these requirements in the use permit for the solar facility, in its decommissioning ordinance, if it exists, as a condition of the decommissioning insurance approval process, or where otherwise relevant and prudent.

Guarantee by an Investment-Grade Entity

An investment-grade entity holds long-term unsecured debt obligations rated at least BBB- or above from S&P Global Ratings and Baa3 or above from Moody's Investors Service, or holds a comparable credit rating from a currently registered Nationally Recognized Statistical Ratings Organization (NRSRO) such as Fitch or Egan-Jones (SEC, 2017; SEC, 2022). A solar company which qualifies as an investment-grade entity could extend a parent guarantee or promissory letter as proof for the locality that it will fulfill its decommissioning responsibilities. Alternatively, if a solar developer has a sufficiently large, stable, and tangible net worth to pass a corporate financial test, a locality may waive the requirement to post decommissioning security, accepting the financial test as a demonstration of the company's ability to self-insure decommissioning costs.

Corporate Financial Test

A company meeting the requirements of a corporate financial test indicates its ability to self-insure for the cost of decommissioning based on the magnitude and soundness of its net worth and working capital. Passing a corporate financial test is not equivalent to a legally binding guarantee that an investment-grade company will uphold its decommissioning requirements, but because a company can only pass the test if its net worth is six times the sum of the estimated decommissioning and land restoration costs it will face, it is unlikely that a company which passes the test would go bankrupt in the next year. As long as a company continues to demonstrate financial solvency by passing the corporate financial test, the locality may waive the developer's requirement to post decommissioning security through a third party without exposing itself to any significant risk of bearing decommissioning costs for an abandoned project.

The following corporate financial test procedure is based on the EPA's guiding practices on decommissioning security for end-of-life RCRA Subtitle C facilities. Subtitle C sites, such as deactivated nuclear power plants or municipal solid waste landfills, involve the containment of hazardous waste. While end-of-life PV panels may be subject to RCRA disposal guidelines, solar farms themselves are neither toxic nor pollutive of air, water, or soil resources, and follow decommissioning processes quite different from RCRA Subtitle C facilities. The EPA's guiding practices for corporate financial tests in non-analogous decommissioning situations provide a useful framework of the financial proofs which solar developer should provide if they seek valid alternatives to posting working capital as decommissioning security during the project's life.

There are two separate tests, or "alternatives" within a corporate financial test. Each alternative has four criteria. To pass a corporate financial test, a company must fulfill all four criteria within a single alternative. Criteria one and two are the same across both alternatives:

<table>
<tr><th>Alternative I</th><th>Alternative II</th></tr>
<tr><td colspan="2">Criterion 1: The company must have a tangible net worth greater than $10 million.</td></tr>
<tr><td colspan="2">Criterion 2: The company's U.S. assets equal at least 90% of its total assets or six times the sum of its decommissioning and land restoration obligations.</td></tr>
<tr><td>Criterion 3: The company's net working capital and tangible net worth must each be at least six times the sum of its decommissioning and land restoration obligations.</td><td>Criterion 3: The company's tangible net worth must be at least six times the sum of its decommissioning and land restoration obligations.</td></tr>
</table>

Criterion 4: The company must pass at least two of the three following ratios:

- Its ratio of total liabilities to net worth must be less than 2:1.
- Its ratio of the sum of net income, depreciation, depletion, and amortization to total liabilities must be greater than 1:10.
- Its ratio of current assets to current liabilities must be greater than 1.5:1.

Criterion 4: The company's most recent bond issuance must have a rating of at least BBB from Standard & Poor's and at least Baa from Moody's.

If the company responsible for decommissioning the solar facility passes the corporate financial test, the locality should monitor the company's financial status throughout the project life to verify the company's ability to self-insure the estimated decommissioning costs. The locality can build these monitoring practices into the conditions for using a corporate financial test by applying the following:

- The locality could require the company to provide its financial statements for the most recent year to an independent Certified Public Accountant, who shall examine and produce an audit report on them.
- The financial test must be re-taken at least every year and when decommissioning cost estimates change to verify that the guarantor maintains at least the minimum tangible net worth and bond rating.

Separate from use requirements, a locality accepting a corporate financial test should further:

- Verify the company's bond ratings and financial ratios annually. A locality may also be able to access the company's Form 10-K filed with the SEC, if the company has at least $10 million in assets and at least 500 shareholders, or if its lists its securities on an exchange or NASDAQ. A Form 10-K offers a useful summary of the corporation's business and financial condition upon the end of its fiscal year, including audited statements (SEC, 2021).
- Remain aware of negative changes in (i) the size of the buffer by which the company passes the financial test, (ii) the company's fiscal year-end, and (iii) business press regarding the company's bond ratings, stock prices, or mergers and acquisitions, as any of these may indicate the company's financial distress.

Parent Guarantee

A parent guarantee is only available to solar developers affiliated with a parent company with a large and stable net worth (MDOC, 2018, p. 9). Similar to a corporate financial test, the locality is responsible for assessing the parent company's financial ability to bear the costs of decommissioning and may consider the parent company's asset to liability ratio, net worth, and credit exposure. Utilities regulated by the SCC, such as Dominion Energy, are typically able to offer parent guarantees for decommissioning security. Depending on additional state and federal regulations which their subsidiary division is subject to, a publicly regulated utility may prefer to offer a comparable form of financial assurance, such as a promissory note.

Promissory Note

An owner or operator of a solar facility who gives a promissory letter or promissory note for decommissioning makes a legally binding, unconditional promise to pay the costs associated with decommissioning an end-of-life or abandoned solar facility to the holder of the note, namely the locality, if the facility is not decommissioned in the required manner. Promissory notes typically provide a maturity date and specify the amount of the promised payment, along with the terms for payment.

Additional Considerations

Localities Rarely Accept Salvage Value Alone as FA

While the estimated decommissioning cost should factor salvage value, localities generally do not accept salvage value alone as sufficient financial assurance for decommissioning, even in cases where an engineer's decommissioning cost estimate suggests that salvage value exceeds removal costs. In the current market, salvage values exceeding the total decommissioning cost estimate may overstate resale and recycling values. This may change as secondary markets develop and is an important area for monitoring and future research.

Pooled Funds

It is impractical and highly costly both to the developer and the locality to implement a pooled fund to assure decommissioning. Pooled funds are used—often under federal mandate—to decommission highly-regulated sites such as nuclear plants, oil wells, and hazardous waste facilities (MDOC, 2018; 26 CFR §1.468A-5). Owners of the same category of facility deposit payments or investment options into a decommissioning fund which each contributing owner may access under specific circumstances to execute decommissioning. The high levels of funding and administrative expertise necessary to operate a pooled fund, matched with the relative simplicity of decommissioning utility-scale solar facilities, make pooled funds an economically infeasible FA mechanism for solar sites.

Pooled Insurance

A similar approach, pooled insurance for decommissioning, is infeasible at present for different reasons. Under a pooled insurance model, multiple solar developers could fund decommissioning security by contributing individual premiums to a group fund. A neutral manager of the pool, typically an insurance underwriter, would evaluate each project's decommissioning plan, each developer's financial status, and a table of historical losses—that is, decommissioning liability claims—from comparable sites to determine individual participants' risk that they would fail to complete decommissioning. This probability of failure, multiplied by the facility owner's total decommissioning obligation and factoring any administrative costs for managing the insurance pool, would yield the developer's contribution to the fund. In the event that one of the participating developers should default on their obligation, the full FA amount would be paid out from the fund to the affected locality.

There are several likely challenges associated with the take-up and rollout of a decommissioning insurance pool. As of August 2022, no insurers in the Commonwealth of Virginia underwrite pooled decommissioning insurance policies for utility-scale solar facilities. Nationally, the limited cases where pooled insurance for utility-scale solar projects have occurred are in relation to liability claims, such as from hailstorm damage or wind-loosened panels, and not EoL decommissioning (Schwab, Walker, & Desai, 2020). Moreover, because there is a very limited history of defaults on solar decommissioning obligations, it would be difficult for an underwriter to establish a schedule of actuarially fair prices for developers. If an underwriter overestimates a facility owner's default risk, the insurance premium paid by the owner could be relatively higher than under an individual insurance policy or alternative FA mechanism, and therefore present a suboptimal FA situation for the solar developer. Conversely, if the insurer undercalculates the facility owner's default risk, it will be responsible for paying extensive FA claims to the locality in the event of failure to decommission. While it is unlikely that the pool of funds would be insufficient to pay out decommissioning claims to localities, it remains possible that localities could face additional complications or lags in their access to a pool of funds if multiple project owners default on their decommissioning obligations.

Applying a pooled insurance paradigm further requires solar projects across counties to participate in the same pool. This restricts the pooled insurance mechanism to future projects, demands greater coordination across localities, and could introduce delays to projects where coordination is uncertain or pre-coverage negotiations are necessary. While a decommissioning insurance pool is possible, the lack of a relevant model for utility-scale solar facilities may make it a daunting FA alternative for both localities and solar developers at this time.

Summary of Financial Assurance Mechanisms

FA Mechanism	Description	Benefits	Disadvantages	Additional Considerations
Trust Fund	The solar developer ("Grantor") transfers assets sufficient to cover the estimated decommissioning costs to a trust held and administered by a financial institution ("Trustee").	Can be used alongside a surety bond or letter of credit. Phased deposits may be allowed. If the trust fund accrues investment income, the locality may thus reduce future deposits required from the Grantor.	Excepting standby trust funds: highly expensive to establish and maintain; subject to market volatility. If facility ownership changes, the trust fund does not automatically transfer to the successor company.	Trustee manages assets for the benefit of the locality ("Beneficiary"). If the trust's value exceeds the decommissioning cost estimate, funds may be released to the solar company.
Cash Escrow	The solar developer deposits funds sufficient to cover the estimated decommissioning costs to an account at a federally insured financial institution.	Phased deposits may be allowed. Funds in the cash escrow account will be released to the developer if decommissioning is appropriately executed.	Highly expensive to establish. May be the only FA mechanism available to solar developers with less credit access.	Scheduled deposits rather than upfront payment and factoring salvage value can reduce expense. Escrow agent is an impartial asset holder.
Letter of Credit (LC)	The issuing bank substitutes its credit for the developer's. Establishment requires the developer to post collateral usu. worth 0.5% to 1% of the LC's face value. If facility ownership changes, the prior owner is not released from the LC until the successor company provides alternate FA.	Relatively easier for a locality to verify LC's value and access LC than is the case with a cash escrow account. In some cases, it may be easier for a locality to access LC funds than surety bond funds. An irrevocable LC cannot be revoked or altered by the issuing bank or developer.	Costly annual renewal fees. May negatively affect the solar company's credit and borrowing access. LC does not automatically transfer to successor company if facility ownership changes.	The locality may wish to include an evergreen clause so the LC automatically renews each year. Requires a standby trust agreement. (Irrevocable LC:) The Surety can alter the payout amount only with the consent of the bank, the locality, and the developer.
Surety Bond	The Surety, a bond company or bank insurance company, provides its financial backing to the locality on behalf of the developer, and takes on decommissioning obligations up to the bond limits if the developer ("Principal") abandons or fails to decommission the facility.	Generally maintained through the Principal's payment of an annual premium equaling 1 to 3% of the bond's face value. Publicly filed, and therefore relatively easier for a locality to verify surety bond's value than is the case with a cash escrow account. May be less expensive for developer than cash escrow or LC.	Can be an expensive option, depending on cost of annual premium. Locality must file a written claim with Surety to obtain decommissioning funds. Surety verifies locality's claim that decommissioning terms have been violated before granting the locality access to the FA.	Payment bonds and performance bonds differ. A payment bond requires a standby trust agreement. For a performance bond, the bonding company may pay out funds to a standby trust fund *or* hire a contractor to execute decommissioning. Cost paid by Principal depends on creditworthiness and project risk.

FA Mechanism	Description	Benefits	Disadvantages	Additional Considerations
Insurance	(Finite policy:) The solar company pays the insurer the net present value of the expected decommissioning liability. The locality may direct the insurer to reimburse the solar company for incurred decommissioning costs.	Can be used with other FA mechanisms. Insurance premium may be paid as a single up-front cost or in phases. Responsive to adjustments in decommissioning cost estimate.	Can be prohibitively expensive, as the company pays for decommissioning twice before reimbursement. The locality should monitor both the insurer's financial solvency and that the solar company pays all its premiums.	No standby trust fund is required. May take the form of a fully-funded (finite) policy or, less commonly, a risk transfer policy. The insurer can only cancel the policy if the company fails to pay its premium.
Corporate Financial Test	Developer self-insures cost of decommissioning (i.e., does not post security) by proving large and stable net worth.	Developer is extremely unlikely to become financially insolvent.	Generally excludes developers unaffiliated with parent companies, or whose parent companies do not have a large and stable net worth.	Locality should verify and monitor company's financial ability to bear decommissioning obligations throughout the project life, potentially increasing the locality's administrative costs.
Promissory Letter or Parent Guarantee	Developer's parent company proves financial solvency and promises to pay any decommissioning obligations.	Parent company is unlikely to become financially insolvent. Developer does not usually post decommissioning security. Usually limited in application to publicly regulated utilities.		

WHEN SHOULD A LOCALITY REQUIRE AN OWNER OR AFFILIATE TO POST FA?

The cost-minimizing, security-maximizing timeline by which an owner should post financial assurance may vary across projects. Requiring decommissioning surety prior to or upon energizing a solar project offers localities immediate financial protection but also raises developers' capital costs considerably, particularly where a solar project has not yet begun creating revenue (Curtis et al., 2021, "*A Survey*…", p. viii). Pre-construction surety requirements may thus disincentivize developers from offering proposals or lengthen the construction phase of approved projects (NYSERDA, 2020).

Surety posted at the power purchase agreement's (PPA's) expiration offers little long-term security to localities lacking the legal protections of abandonment and liability clauses. Apart from a force majeure event, it is extraordinarily unlikely that a solar facility with a PPA will cease operations during the project life, thereby decreasing the risk of abandonment. Later-phase surety may make a county or city relatively more competitive if it is seeking solar projects. Later posting further allows operators the benefit of paying FA as an operating cost, rather than an initial capital cost (Curtis et al., 2021, p. 29). Intermediate posting options are described in greater detail below.

If a locality desires access to decommissioning security prior to the site's construction, sufficient assurance can be accessed by requiring the project owner to provide evidence of liability insurance for the facility. This avoids levying a cost-prohibitive financial assurance condition—namely, providing most or all of the FA before operation—on the developer while simultaneously protecting the locality against site abandonment in the solar project's early life. Note that liability insurance differs from a risk-transfer policy.

Requiring a developer to post the most or all of the surety amount upon reaching the middle or first third of the solar facility's anticipated life allows the project owner to pay financial assurance as an operating cost. This allows the locality to receive decommissioning security long before the facility's scheduled deactivation without threatening the project's financial viability. For example, the City of Suffolk requires the following financial assurance from Myrtle Solar Farm, LLC (15 MW):

> "Beginning in year 10, the solar energy facility owner will obtain a letter of credit, bond, or such other security in an amount equal to the cost of performing the restoration obligations minus the salvage value of the Solar Energy Facilities on the property."

A phased financial assurance approach may be similarly beneficial if the solar developer is a smaller firm with less access to credit than a publicly regulated electric utility. Under this condition, the project owner would post security to a cash escrow account or attain additional surety bonds or letters of credit according to a pre-specified schedule. Depending on the locality's preferences, a developer may make constant or variable payments in regular intervals.

For example, the conditional use permit approval for Twitty's Creek Solar (13.8 MW) in Charlotte County, Virginia outlays the following schedule of annual deposits to a reserve fund. Note that the schedule below does not account for interest on the fund balance:

Operating Year	Deposit	Cumulative Fund	Percent of Decommissioning Cost Posted
1	$40,900	$40,900	6.79%
2	$39,600	$80,500	13.37%
3	$37,400	$117,900	19.57%
4	$36,600	$154,500	25.65%
5	$37,400	$191,900	31.86%
6	$36,100	$228,000	37.85%
7	$35,300	$263,300	43.72%
8	$32,700	$296,000	49.14%
9	$30,000	$326,000	54.13%
10	$27,000	$353,000	58.61%
11	$23,500	$376,500	62.51%
12	$20,500	$397,000	65.91%
13	$17,000	$414,000	68.74%
14	$13,900	$427,900	71.04%
15 to 30	$10,900 per annum	$602,300 by Year 30	100% by Year 30

Another phased FA approach is embodied in a proposed amendment to Pennsylvania Senate Bill 284 (S.B. 284 AO3939, 2022) at the time of this paper's writing, which suggests the project owner should post the estimated decommissioning cost in ten percent increments every five years, beginning thirty days before the solar facility's construction. Once the solar facility is established, the amendment recommends the following conditions take effect:

- Ten years after the initial security posting, the owner will provide 40% of the estimated decommissioning costs.
- Fifteen years after the initial security posting, the owner will provide 60% of the estimated decommissioning cost less the facility's salvage value, subject to the exception that the security amount factoring salvage shall be no less than 40% of the estimated cost of decommissioning.

- Twenty years after the initial security posting, the owner will provide 80% of the estimated decommissioning cost less the facility's salvage value, but the security amount factoring salvage shall be no less than 60% of the estimated cost of decommissioning.
- Twenty-five years after the initial security posting, the owner will provide 100% of the estimated decommissioning cost less the facility's salvage value, but the security amount factoring salvage shall be no less than 70% of the estimated cost of decommissioning.

These phased deposits provide the locality with the security of access to most of the decommissioning surety prior to the project's half-life without requiring steep commitments of financial assurance from the developer early in the project.

DETERMINING DECOMMISSIONING COSTS

A decommissioning cost estimate must be prepared or at least reviewed by a Virginia-licensed engineer prior to submission to the locality's Board of Supervisors, County Administrator, or other relevant official (Va. Stat. §15.2-2241.2). To ensure that decommissioning costs reflect price changes due to inflation and any non-uniform variation in costs among components of the decommissioning process, many Virginia localities require periodic updates of the decommissioning cost estimate, usually no less frequently than every ten years and no more frequently than every five years. The Code of Virginia allows but does not mandate the inclusion of a salvage value, which may be subtracted from the gross decommissioning cost to yield a net decommissioning cost estimate. In any case, the decommissioning cost estimate applied by the locality cannot exceed the licensed engineer's projected cost of decommissioning (Va. Stat. §15.2-2241.2).

VALUATION OF THE ADMINISTRATIVE FACTOR

Some decommissioning ordinances and special use permit conditions apply an "administrative factor" equaling ten to twenty-five percent of the gross decommissioning cost, or removal cost. The administrative factor is added to the gross decommissioning cost and has several intended functions: Section 2241.2 of the Code of Virginia allows localities to include "a reasonable allowance for the estimated administrative costs related to a default of the owner, lessee, or developer [of a solar facility]". In specific cases where the Virginia Department of Transportation has notified the locality that road damage is possible during site removal, the administrative factor assures that necessary road improvements will occur in a timely manner without cost to the public. It also acts as a reserve or buffer protecting the locality against any significant changes in the salvage credit claimed by the developer.

Although the terms "administrative factor" and "inflation factor" are often used interchangeably, the term "inflation factor" is misleading. Inflation, being any general changes in the prices of goods and services throughout the economy, is naturally accounted for in the periodic re-calculation of the decommissioning cost estimate. Non-inflationary, industry-specific changes in the prices of solar hardware and the cost of decommissioning labor will also be fully accounted for in the re-calculation. Requiring an inflation factor as allowed in Section 2241.2 of the Code of Virginia is only useful if the decommissioning cost estimate is not regularly updated. If an annual inflation factor is preferred to a periodic recalculation, the locality should apply the industrial inflation rate as published in the Bureau of Labor Statistics' producer price index (PPI).[7]

[7] *Author's Note:* The Bureau of Labor Statistics (BLS) regularly updates the PPI. Updates to the PPI database can be accessed online at: https://www.bls.gov/ppi/databases/.

The following statements exemplify superfluous special use permit conditions, and are not recommended in cases where a professional engineer recalculates decommissioning costs at least every five years:

- "The decommissioning cost estimate must include a provision for inflation."
- "The decommissioning cost estimate shall be updated every five years from the date of approval and include the inflation rate as published by the Bureau of Labor Statistics, CPI."
- "The project owner's decommissioning cost estimate shall be increased by twenty percent (20%) of said estimate costs as a reasonable allowance for administrative costs, inflation, and potential damage to existing roads or utilities during site removal."

The following alternatives are both economically accurate and legally sound:

- "The owner shall supply bond riders or replacement bonds, upon request by the Locality, to account for inflation and changes in anticipated costs."
- "The decommissioning plan shall be updated and filed with the County / City every five years to account for changed circumstances, including inflation."
- "The project owner's decommissioning cost estimate shall be increased by twenty percent (20%) of said estimate costs as a reasonable allowance for administrative costs and potential damage to existing roads or utilities during site removal."

SALVAGE CREDIT

Salvage Plan

The salvage plan is the portion of the decommissioning plan stating the description and quantities of solar waste components that will be recycled, resold in a licensed secondary market, or landfilled. A salvage plan should be prepared regardless of whether a locality factors salvage value. A project owner should also report the salvage value, or residual value of recycled or resold hardware as calculated by a Virginia-licensed engineer, alongside the decommissioning cost estimate even if the locality does not allow a salvage credit equaling part or all of the salvage to be subtracted from the decommissioning cost. Salvage values may change as the market for recycling and re-selling used solar hardware continues to develop.

When to Allow a Salvage Credit

It is considered good practice for localities to factor salvage value by allowing a solar facility's owner or affiliate to subtract a salvage credit from the estimated cost of decommissioning, particularly as recycling and resale markets for solar technologies grow more robust. Including a salvage credit allows the project owner to post a lesser but sufficient financial assurance should the locality need to take over system decommissioning.

Localities can include a salvage credit while protecting against fluctuations in salvage value. This can be broadly accomplished by applying a reserve in the decommissioning cost estimate to protect against price volatility over the project life; for example, a locality may award a salvage credit by reducing the estimated salvage value by twenty percent while increasing the gross cost estimate by twenty percent (Maamari, 2018). The North Carolina Department of Environmental Quality similarly recommends that a locality exclude a specific percentage of salvage value from the offset calculation and revise it over time as recycling and reuse markets grow (2022, p. 12). To date, because salvage value estimates are subject to considerable uncertainty, localities generally do not accept salvage credit alone as sufficient decommissioning security in cases where the predicted salvage value exceeds the decommissioning cost estimate. In every case, salvage value estimates should come from an independent engineer rather than from a solar developer or facility owner.

Salvage Credit Calculations

Examples of salvage credit valuation from existing Virginia projects for which the salvage value equals the estimated resale and recycling values associated with decommissioned equipment include:

- The salvage credit equals eighty percent of the salvage value. (CUP Approval, Eastern Shore Solar, Accomack County; CUP Approval, SunTec Solar, Accomack County; CUP Approval, Southampton Solar, Southampton County)
- The salvage credit equals ninety percent of the salvage value. (CUP Approval, Spring Grove Solar, Surry County)
- The salvage credit equals fifty percent of the salvage value. (Southampton County Code, §18-637)

Additional examples provided by the North Carolina Department of Environmental Quality suggest the following salvage credit valuations:

- 125% of the estimated net cost of decommissioning established within the approved decommissioning plan, or 25% of the estimated decommissioning cost excluding salvage value, whichever is greater; or
- 1.25 times the estimated decommissioning cost minus the salvageable value; or
- Either the difference of the estimated decommissioning cost and 50% of the salvageable value, or $75,000, whichever value is greater.

SUMMARY OF RECOMMENDATIONS

The best practices for a locality to adopt when establishing regulations and financial assurance options for utility-scale solar facilities will depend on the size and duration of the project, the financial characteristics of the project developer, and the intended future use of the real property on which the project is situated. Host localities should expect that specific details of their decommissioning agreements with the developers of approved solar facilities will vary in accordance with the context of each project. Key considerations to weigh across all projects include:

- **The local legal framework for utility-scale solar facilities;**

If the locality has incorporated decommissioning regulations into its zoning ordinance, then any subsequent decommissioning agreements and decommissioning plans are, at minimum, subject to the requirements specified therein. Localities may wish to consider which legal mechanisms should apply when determining whether a utility-scale solar facility should be repowered instead of decommissioned.

A decommissioning ordinance—whether codified in the zoning ordinance or applied as a condition for land use—should define "decommissioning" and "abandonment" to avoid legal ambiguity and state the rights and rules of the locality regarding the decommissioning process. These rules may include clauses enforcing the project owner's legal liability for paying the costs associated with removing and restoring the site, describing the conditions under which the locality would be allowed to inspect the facility, and restating the locality's right to enter and remove the facility without the owner's consent in the event of the owner's failure to decommission. Emerging best practice is to allow between twelve and twenty-four months of continuous inactivity before declaring a facility abandoned, and to provide at least twelve months for decommissioning to be completed from the time of the facility's abandonment or end-of-life.

- **Specifying appropriate decommissioning plan contents;**

In every case, it is prudent to require a decommissioning plan to state the project owner's contact information, the site's anticipated project life, current land use, and proposed land use, a clearly-explained calculation of the estimated present-value cost of decommissioning, a description of the locality-approved financial assurance, a decommissioning narrative, a salvage plan—even in cases where the locality does not factor a salvage credit—and a land restoration plan. It may be necessary to include such measures as decompaction and soil restoration in the land restoration plan, depending on the property owner's intended future use for the land.

- **Which financial assurance options are optimal to require of a developer;**

Legally enforceable access to sufficient financial assurance (FA) to carry out decommissioning plays an essential role in reducing the host locality's risk of bearing the cost burden for removing a deactivated solar facility and restoring the project site to an appropriate condition. Nationally, localities tend to reject FA proposals that would substitute a salvage value estimate outweighing the gross cost of decommissioning (i.e., a net gain from decommissioning) as sufficient decommissioning security. Best practice provides that the surety amount be adjusted at least every five years based on a Virginia-licensed engineer's re-evaluation of decommissioning costs. Any salvage value estimate could also be updated at this time. To maintain security in the event that a developer becomes financially insolvent, localities should require FA to remain posted until all decommissioning requirements have been fulfilled.

Trust funds, fully-funded or risk-transfer insurance policies, and cash escrow accounts should be used with caution, as they may become prohibitively expensive for the facility owner. Surety bonds generally provide localities the same level of financial assurance as letters of credit and cash escrow accounts without affecting solar developers' access to credit or working capital. If a project owner can fulfill the capital requirements of a corporate financial test, parent guarantee, or promissory note, localities should consider accepting such mechanisms as decommissioning security; in such case, the locality will bear the administrative burden of verifying the information and business status provided by the developer or its parent company.

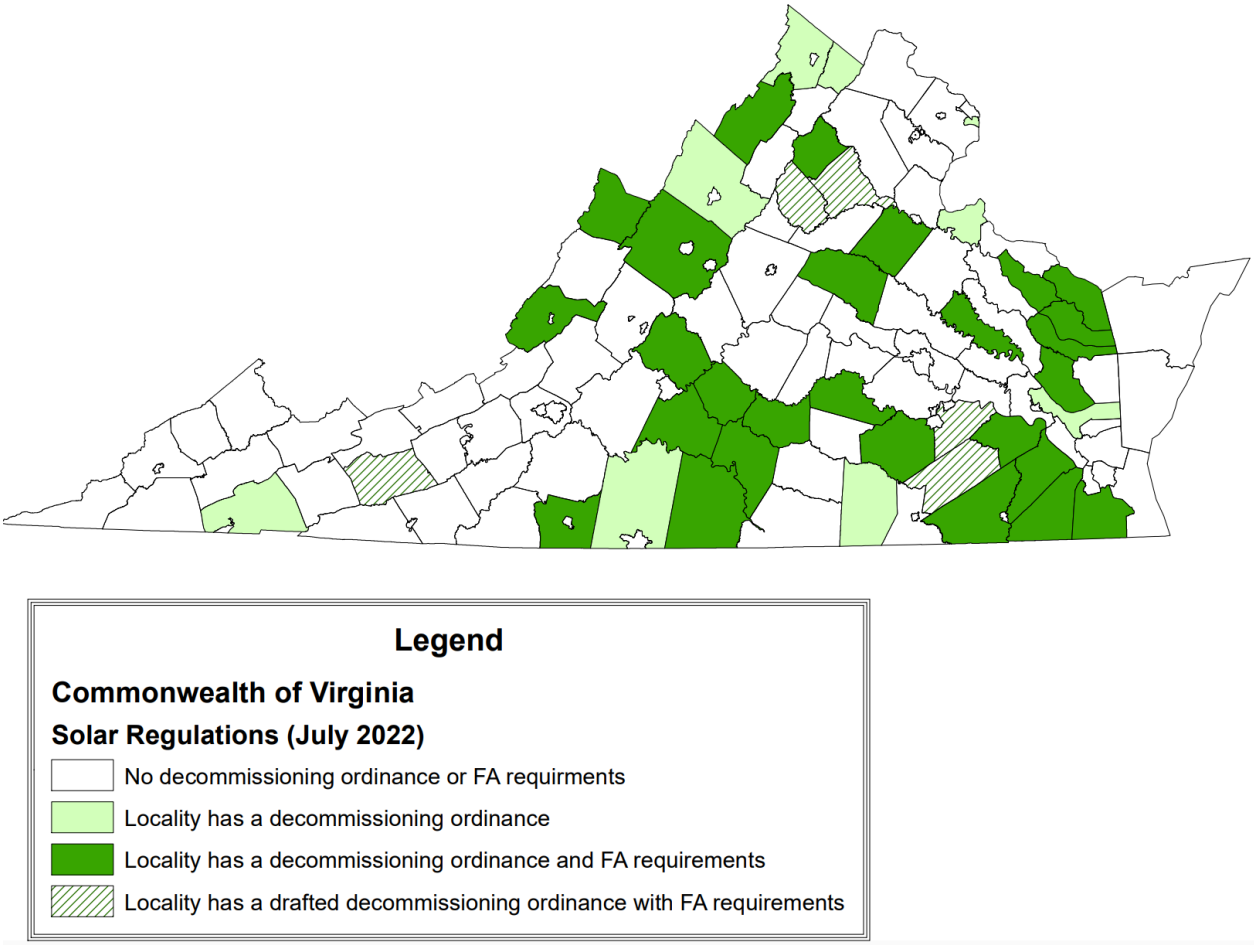
To avoid delaying projects due to high capital costs or imposing undue financial hardship on the solar developer, localities should consider requiring FA payments in phases or in the full amount once the project is operational, rather than as a lump-sum during site development.

- **If and how inflation, administrative costs, and salvage values should be factored into the decommissioning cost estimate.**

Localities can account for inflationary changes in the decommissioning cost estimate by annually applying an inflation factor to the original estimate. For a more precise assessment of decommissioning costs, localities should instead have a Virginia-licensed engineer periodically recalculate the decommissioning cost, no less frequently than every five years from the estimate's original filing with the locality. Based on emerging best practice, localities should also allow the salvage value of solar equipment and site hardware—or, a salvage credit equaling a substantial portion of the salvage value—to be subtracted from the gross decommissioning cost, as end-of-life equipment will retain a resale value even where recycling streams do not exist. Salvage value estimates should never come directly from a site owner or solar developer, but rather be prepared by an independent engineer.

Altogether, localities have ample discretion in determining and enforcing appropriate decommissioning practices for utility-scale solar facilities in the Commonwealth of Virginia. The principles and mechanisms detailed here are intended to provide localities with a helpful inventory of regulatory options which can be tailored to the characteristics of the solar facilities they host.

APPENDIX A: DECOMMISSIONING REGULATIONS BY VIRGINIA LOCALITY, AS OF JULY 2022



As of July 2022, the following localities…

- **… Have neither a utility-scale solar decommissioning ordinance nor locally codified FA requirements:** Accomack County, Albemarle County, City of Alexandria, Arlington County, Bath County, Bland County, Botetourt County, City of Bristol, Buchanan County, Buckingham County, City of Buena Vista, Caroline County, Carroll County, Charles City County, City of Charlottesville, Chesterfield County, City of Colonial Heights, City of Covington, Craig County, Cumberland County, City of Danville, Dickenson County, City of Emporia, Essex County, City of Fairfax, Fairfax County, City of Falls Church, Fauquier County, Floyd County, Fluvanna County, City of Franklin, Franklin County, City of Fredericksburg, Galax City, Giles County, Goochland County, Grayson County, Greene County, Greensville County, City of Hampton, Hanover County, Henrico County,

City of Hopewell, James City County, King and Queen County, Lee County, City of Lexington, Loudon County, Lunenburg County, City of Lynchburg, City of Manassas, City of Manassas Park, City of Martinsville, Mathews County, Mecklenburg County, Nelson County, New Kent County, City of Newport News, City of Norfolk, Northampton County, City of Norton, Nottoway County, Orange County, Page County, Patrick County, City of Petersburg, City of Poquoson, City of Portsmouth, Powhatan County, Prince William County, Pulaski County, City of Radford, City of Richmond, City of Roanoke, Roanoke County, Rockbridge County, Russell County, City of Salem, Scott County, Smyth County, Stafford County, City of Staunton, Tazewell County, City of Virginia Beach, Warren County, City of Waynesboro, Westmoreland County, City of Williamsburg, City of Winchester, Wise County.

- **… Have a utility-scale solar decommissioning ordinance, but no locally codified FA requirements:** Brunswick County, Clarke County, Frederick County, King George County, Pittsylvania County, Rockingham County, Washington County, York County.

- **… Have both a utility-scale solar decommissioning ordinance and locally codified FA requirements:** Alleghany County, Amelia County, Amherst County, Appomattox County, Augusta County, Campbell County, Charlotte County, City of Chesapeake, Dinwiddie County, Gloucester County, Halifax County, Henry County, Highland County, Isle of Wight County, King William County, Lancaster County, Louisa County, Middlesex County, Northumberland County, Prince Edward County, Rappahannock County, Richmond County, Shenandoah County, Southampton County, Spotsylvania County, City of Suffolk, Surry County.

- **… Have considered or are considering a drafted decommissioning ordinance with FA requirements:** City of Chesapeake (new FA requirements), Culpeper County, Prince George County, Sussex County; Town of Wytheville has adopted a decommissioning ordinance with FA requirements, but Wytheville County has not.

APPENDIX B: DECOMMISSIONING CONSIDERATIONS

The following summary categorizes relevant options for localities to consider when creating decommissioning guidelines for utility-scale solar facilities.

Key: **Mandatory Enforcement** **Discretionary Enforcement**

The locality grants zoning approval for a solar project, or receives an NOI for a by-right project.

State Laws

The following regulations (non-inclusive) apply:

- Va. Stat. § 10.1-1197.6 (HB 206)
- Va. Stat. §§15.2-2316.6:2316.9
- Va. Stat. §15.2-2232
- Va. Stat. §15.2-2241.2
- Va. Stat. §§ 15.2-2288.7:2288.8
- Va. Stat. § 45.2-1708
- Va. Stat. §56-265.2
- Va. Stat. §56-585.5 (VCEA)
- Va. Stat. §62.1-44.15:51
- 9VAC-15-60-30:130
- 20VAC5-302-20

If they exist, any siting and decommissioning regulations codified in a local solar ordinance and/or zoning ordinance.

Site-specific conditions attached to the siting agreement and/or SUP, CUP, or SEP.

Per the terms of Va. Stat. §15.2.-2241.2, project owner must enter into a written agreement with the locality that it will decommission the solar facility.

Continued on following page.

What additional decommissioning measures should the locality consider?

Decommissioning Plan:

- Contact information
- Anticipated project life
- Cost estimate
- Decommissioning narrative
- Salvage plan
- Restoration plan

Timeline:

- When is a project deemed "abandoned"?
- What is the facility's EoL?
- What is the maximum permissible timeframe for decommissioning?
- Can the facility owner file for an extension on the decommissioning process? If so, what is the procedure for approval?
- Is the locality willing to negotiate an extension on the lease or use permit in the event that a project can be repowered upon EoL?

Legal Protections for the Locality:

- Clear definitions of "decommission" and "abandonment"
- Distinguish between periods of continuous inactivity which do and do not constitute abandonment
- Entry rights
- Owner's liability for decommissioning.
- Locality's full access to decommissioning financial assurance upon abandonment or failure to decommission in a timely manner
- Procedure for local Notice, exceptions, and extensions on decommissioning
- Temporary variance framework

How should decommissioning costs be calculated?

Decommissioning Cost Estimate (DCE):

Must be prepared by an independent, Virginia-licensed engineer.

Can account for inflation annually with an inflation factor, based on PPI published by BLS.

OR

Can account for inflation and industry changes by recalculating the DCE every 5 to 10 years.

Administrative Factor:

Can be omitted. If included, usually equals between ten and twenty-five percent of the DCE.

Salvage Credit:

Best practice is to factor part or all of the salvage value. Not required under current state law. Never accept directly from the developer; should always be calculated by an independent engineer. Should be recalculated every 5 to 10 years.

What financial assurance (FA) mechanisms should the locality consider?

Accessible for Many Facility Owners:

- Letter of Credit (pp. 29-30)
- Decommissioning Surety Bond (pp. 30-31)

Accessible for Well-Capitalized Facility Owners:

- Parent Guarantee (p. 35)
- Promissory Note (p. 35)
- Corporate Financial Test (pp. 33-34)

Use with Caution:

Can become prohibitively expensive for the facility owner to post or maintain.

- Trust fund (p. 28)
- Fully-funded insurance policy (pp. 31-32)
- Risk-transfer insurance policy (pp. 31-32)
- Cash escrow account (pp. 28-29)

Considered Infeasible at Present:

- Salvage value alone, where salvage value exceeds decommissioning cost estimate.
- Pooled funds (p. 35)
- Decommissioning insurance pool (p. 36)

When should the locality require the facility owner to post FA?

FA should always cover the full cost of decommissioning and should always be posted until decommissioning is complete.

A lump-sum payment of the full decommissioning cost estimate during site construction can cause project delays.

FA payments in a predetermined phased schedule, or in the full amount once a project is operational are less likely to impose undue financial hardship on the facility owner.

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